TRANSFORMATION OF THE ANTI-TANK DITCH DURING THE LAST 80 YEARS – CASE STUDY FROM THE BIAŁA NIDA BASIN (S POLAND)

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ABSTRACT

This study investigates selected remains of modern defensive structures located in the Biała Nida basin (Poland), focusing on factors that have shaped their current condition. The analysed features include several sections of an anti-tank ditch attributed to the German Reich, constructed as part of the A-1 defensive line against the Red Army in the final stage of World War II. Within a relatively small area, these structures were built on highly variable substrates, including fluvial sands and gravels, limestone rubble, and bedrock. Using an integrated approach that combines historical cartographic data, Airborne Laser Scanning (ALS) analyses, field observations and measurements, geomorphological assessments, historical sources, including military instructions, and GIS-based spatial analysis, the main degradation and transformation factors were identified. Natural components, including fluvial dynamics, slope processes, and soil erosion, are evaluated alongside anthropogenic impacts including land-use change, infrastructure development, and agricultural intensification. The results highlight the varying vulnerability of individual sites and demonstrate how the synergy of natural and human-induced processes contributes to differential preservation patterns, thereby enabling the identification and dating of other remains of modern defensive structures.

Keywords: anti-tank ditch, World War II, Biała Nida basin, denudation, geomorphology

INTRODUCTION

The anti-tank ditch that is the subject of this study is an element of the OKH Stellung A-1, a German Army High Command (Oberkommando des Heeres) defensive line constructed by the German Reich against the army of the Soviet Union. It was built in the period July 1944 – January 1945 on the orders of the Chief of the General Staff of the German Army High Command, Colonel General Heinz Wilhelm Guderian, and the construction was supervised by the Schutzstaffel (SS) [1]. This line is located in Poland and runs in an arc from the Pilica River to the Poprad River, along the Nida and Dunajec rivers, intersecting the Vistula River. The examined section ran in the western part of the Świętokrzyskie Voivodeship on the right bank of the Nida and Biała Nida rivers, forming the fortification line (Fig. 1). In the analysed area, this ditch represents two types: an anti-tank ditch on the plain and an escarpe built on the slope, constructed to stop the Workers'

and Peasants' Red Army vehicles attempting to cross the Biała Nida River in their westward offensive. The anti-tank ditch and the escarpe were constructed with hand tools using wooden measuring frames, utilising forced civilian labor (Fig. 2A) and formed part of other field fortifications, engineering structures, and obstacles [2], [3]. The Red Army crossed this line in January 1945 [4].

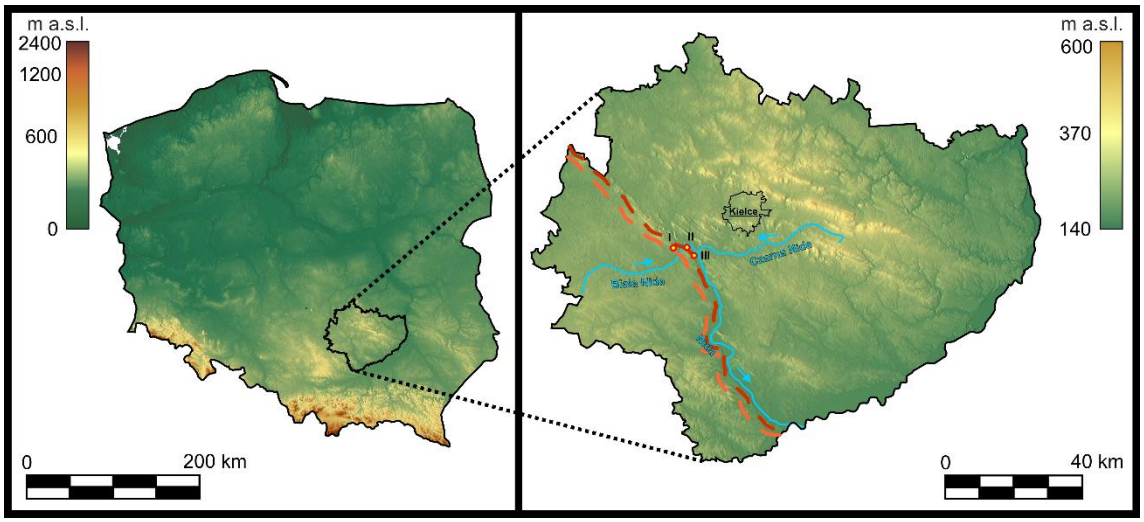


Figure 1. Location of the research area on the Digital Elevation Model (DEM) map [5] of Poland and the Świętokrzyskie Voivodeship with the location of research sites (I, II and III) and the World War II A-1 defensive line (double dashed lines: front red and rear orange)

The technical supervision of the A-1 and A-2 defensive lines (Fig. 1 – red and orange dashed lines) was exercised by the Organisation Todt, as well as the Baudienst im Generalgouvernement (Construction Service in the General Government for the Occupied Polish Region), and technical staff from the Haupttechnische Amt (Main Technical Office) in the General Government [6]. In addition to the regular German army, the works were supervised by the police and the Schutzstaffel (SS), with a specially appointed staff headed by SS-Gruppenführer (Lieutenant General) Jakob Sporrenberg, and the work began with the A-1 defensive line [2]. The supervision was aimed at carrying out the works in accordance with the guidelines (Fig. 2B), which enabled optimal adaptation of the form of the anti-tank ditches to the geological conditions and relief.
According to the German instructions of June 1, 1944, the German anti-tank ditch had a symmetrical, trapezoidal cross-section [7], [8]. Its depth was 2.5 m, increased by embankments 0.5 m high and 8–10 m wide. The upper section was 3.5 m wide, the flat bottom 0.3 m wide, and the wall angle was 55°. In stable ground, a larger ditch could be constructed: 3 m deep, 4.5 m wide at the top, and 0.3–4.5 m wide at the bottom, which resulted from varying the wall angles in the range of 55°–90°. The ditch embankments in such ground were 15–20 m wide. In less stable ground, it could be timbered [7]. Escarpes were used to prevent advances going up, while counterscarpes prevented descents, and collectively they are now called anti-tank ditches. According to German regulations, an escarpe should be created by cutting a flat platform at least 3 m wide into the slope, with a wall inclination ranging from 55 to 90°, the same as in the case of anti-tank ditches on plains. The minimum height depended on the wall inclination angle and was at least 1.43 m at 90°, and at least 2.5 m at 55° [7].

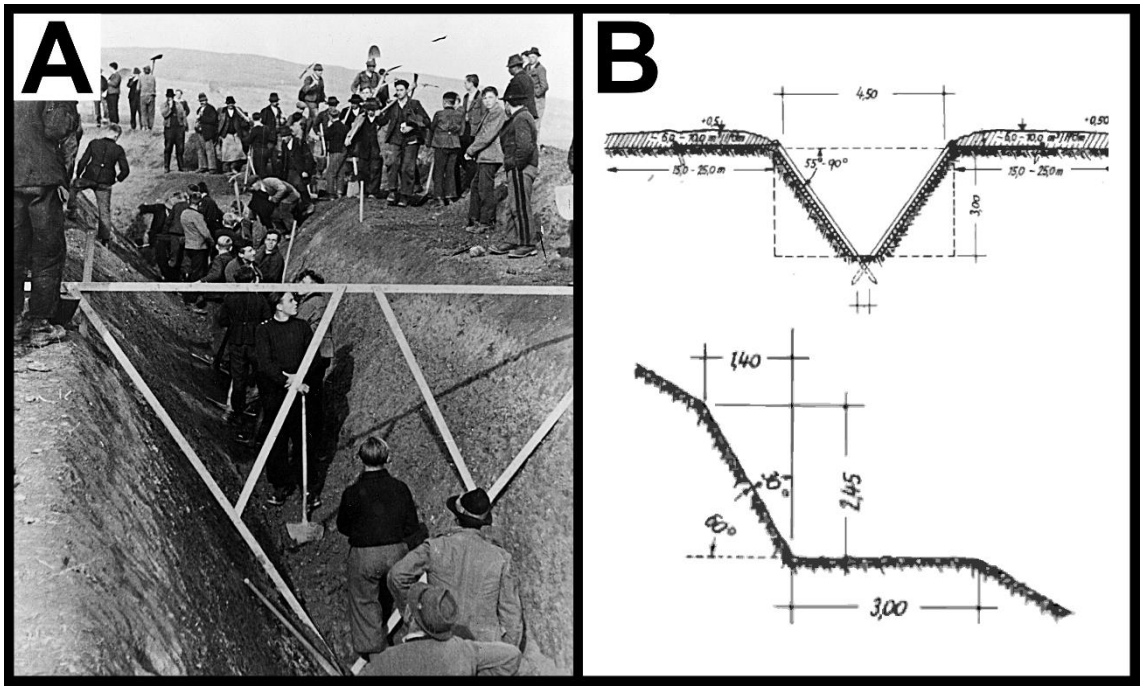


Figure 2. A – Forced labor while digging an anti-tank ditch (Photo by Klacanek 1944, National Digital Archives, Poland, inv. no. 3/2/0/-/6339), B – Diagrams from 1944 with examples of anti-tank ditch and escarpe [7]

AIM OF THE STUDY AND METHODS

The aim of the study was to identify World War II field fortifications in the lower section of the Biała Nida River using interdisciplinary methods, including field survey, ALS data analysis, and historical, geomorphological, and geoarchaeological research [9], [10]. It is important to examine the state of preservation of selected sections of the field fortifications. It depends on the influence of physiographic components in order to identify the dominant processes leading to the obliteration of traces of the World War II anti-tank ditch in the study area. For this purpose, three research areas were selected, differing in terms of geological structure, relief, and land development, where the described anti-tank ditch runs.

RESULTS

The fortifications in the studied section lacked permanent reinforced concrete structures, consisting instead of field fortifications, including firing trenches, an anti-tank ditch, infantry shelters, and vehicle revetments [2], [11]. The anti-tank ditch is clearly visible in the relief within the Świętokrzyskie Voivodeship along almost its entire length. Its sections along the Biała Nida River are particularly well-preserved.

The first (I) site is located near the estuary of the Łososina River (Wierna Rzeka), a left-bank tributary of the Biała Nida River (Fig. 3A). The fortifications were built mainly on a sandy-gravel terrace [12]. The relief is clearly flat and currently used for forestry (Fig. 3A, B). In addition to the well-preserved anti-tank ditch, there are many other elements of field fortifications, including older structures dating back to World War I, which are attributed to the Austro-Hungarian Monarchy (Fig. 3C). The anti-tank ditch is deep, but in some sections, areas of denudation processes and gradual filling of the bottom of the

form by colluvium are visible. In several places, a path runs through the ditch, where these processes are much more visible due to the poorer vegetation, especially in the unforested sections (Fig. 3A, B, C). In some sections, this form even exceeds 2 m in depth, considering the still well-preserved embankments on both sides of the ditch (Fig. 3D).

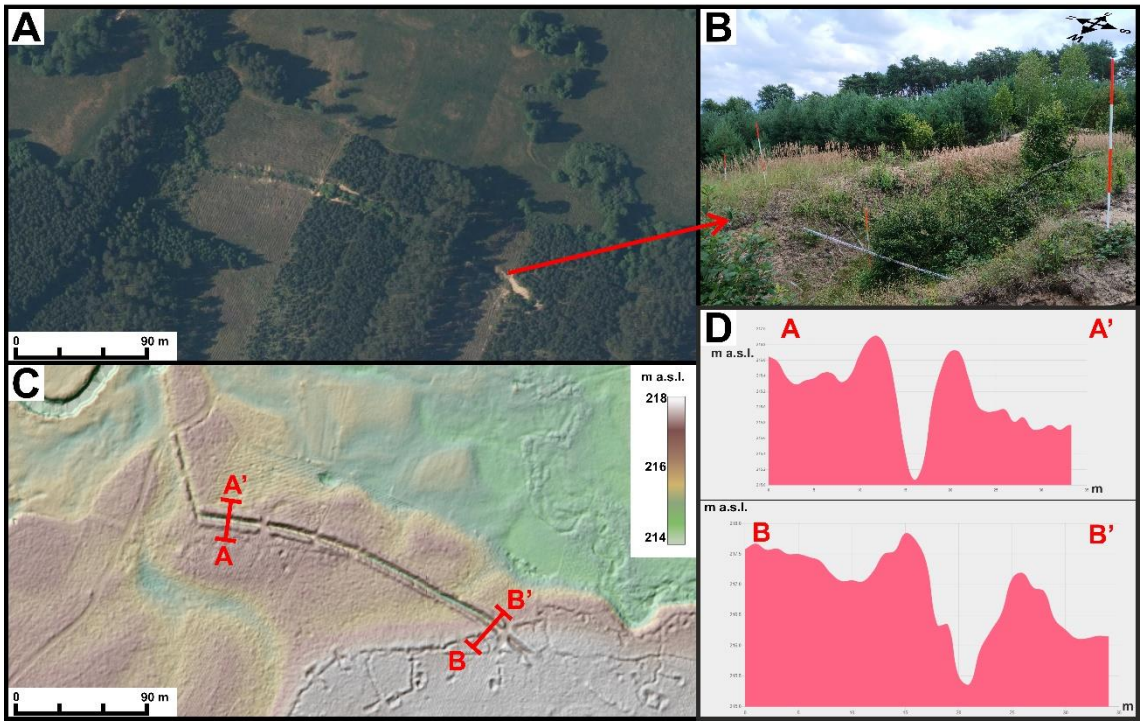


Figure 3. The first (I) study site: A – Area used for forest cultivation with location of anti-tank ditch [13], B – Dug in a sandy terrace anti-tank ditch section (Photo by J. M. Niebylski 2025), C – DEM with well-preserved remains of World War II field fortifications with cross-sections location [13], D – Cross-sections of anti-tank ditch

The second (II) site is located eastward of the first (I) on a steep, rocky, and densely forested slope of the Biała Nida Valley (Fig. 4A). A significant part of the anti-tank ditch was built on limestone outcrops (Fig. 4B, as escarpe), which are adjoined by narrow strips of sandy-gravel terraces [12], on which many elements of the other field fortifications have been preserved (Fig. 4C). The anti-tank ditch running through the rock outcrops is carved into them, creating a distinct, almost vertical scarp, approximately 3 m high, with a flat area below. Along the remaining length, this form has the classic character of a ditch reaching a depth of up to 3 m (Fig. 4D).

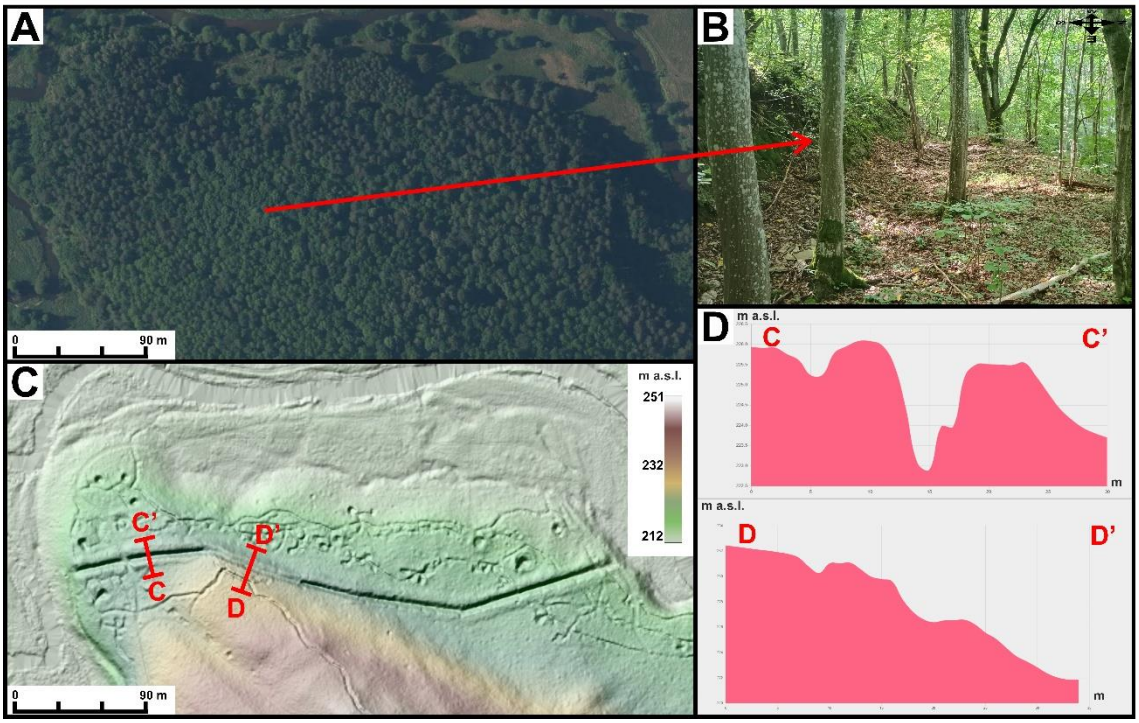


Figure 4. The second (II) study site: A – Difficult-to-access forest area with location of anti-tank ditch and escarpe [13], B – Dug in a rocky hillside escarpe section (Photo by P. Przepióra 2025), C – DEM with well-preserved remains of World War II field fortifications with cross-sections location [13], D – Cross-sections of anti-tank ditch and escarpe

The third (III) site, located in the estuary of the Biała Nida River, on the right, gentle slope of the valley, represents the most denuded section of the anti-tank embankment (Fig. 5A). Sands with silt intercalations and sands with fluvioglacial gravels dominate here [12]. Within the fluvial-denudational valley (Fig. 5B), there are small agricultural plots separated by narrow forest complexes (Fig. 5A). Within the agricultural areas, the study form becomes much flatter, and its average depth does not exceed 0.4 m (Fig. 5C). The ditch becomes more distinct again in the forested sections (Fig. 5A, B).

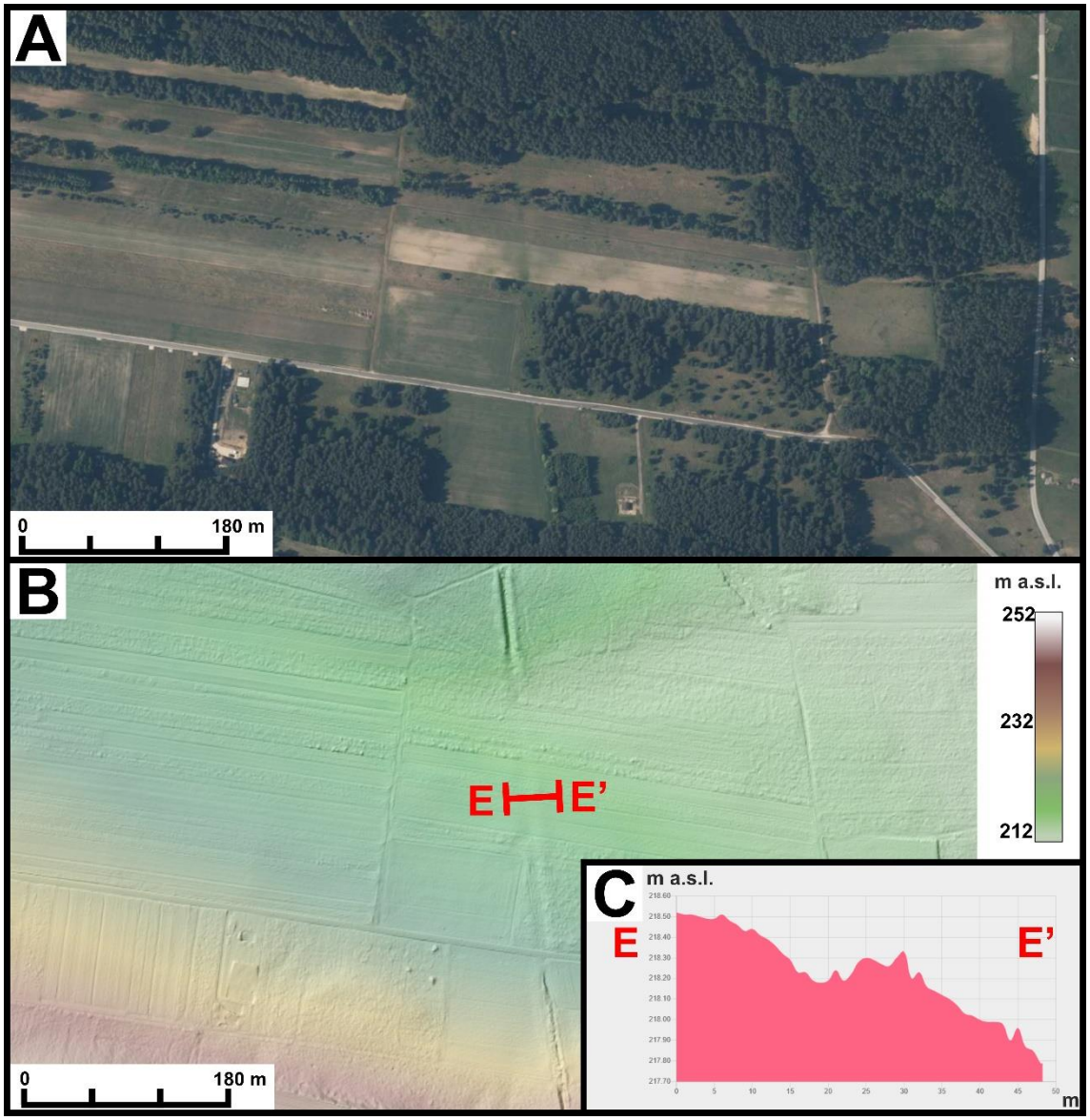


Figure 5. The third (III) study site: A – Area used for agriculture [12], B – DEM with obliterated in the field remains of World War II field fortifications with cross-sections location [12], C – Cross-sections of anti-tank ditch

DISCUSSION

All three selected sections (research sites) represent varying degrees of preservation of the World War II anti-tank ditch and associated escarpe. This variation is primarily due to the state of land use, although the geological structure and topography also play a significant role.

In the case of the first (I) site, the field fortifications are relatively well-preserved due to limited forest management, with this form best preserved in the forested sections. Although this area is composed primarily of sand and gravel [12], the slope is slight and characteristic of a terraced bottom of river valley. Denudation processes are more pronounced in areas frequented by human or animal paths across the anti-tank ditch. The limited vegetation growth in these areas leads to the movement of loose sands down the slope, filling the ditch floor with deluvia, especially during rainfall.

The second (II) site represents a completely different type of anti-tank fortification. Due to the steep sloping and rocky terrain, the method of constructing the anti-tank ditch is more varied. On the sandy-gravel terraces [12], a classic anti-tank ditch, bounded by embankments, occurs, while on the nearby limestone outcrops [12], the fortifications were carved into solid rock. Here, too, the anti-tank ditch has a distinct depression bounded by embankments, but its relief is much better preserved. For a short distance, the ditch transforms into an almost vertical wall as an escarpe. This is due to the engineers' use of natural topography in constructing the fortifications. Currently, the area is heavily forested, and the dominant limestone rocks in which the fortifications were built provide additional durability to the structures. They are best preserved in this studied section also due to the low, contemporary anthropopressure.
The third (III) site represents a section of an almost completely obliterated anti-tank ditch. This is primarily due to long-standing agricultural activity at this location. This is also confirmed by the fact that in nearby, forested sections, this ditch is much better preserved in relief, despite the identical geological structure as in the first (I) site, where sand and gravel with silt interbeds predominate [12]. The more pronounced loss of form at the third site may also be since the anti-tank ditch ran across a small, steeply sloping fluvial-denudational valley, where natural processes leading to erosion and backfilling are more intense.
The field fortifications, particularly the anti-tank ditch, are preserved to varying degrees due to various factors. However, modern development, which accelerates the erosion and accumulation processes of the over 80-year-old anti-tank ditch, outweighs the geological structure and relief. The intensification of these processes leading to the obliteration of the historic military fieldwork requires detailed analysis and further research. This will allow easier future interpretation of these forms in the field and, if necessary, ensure their appropriate protection.

CONCLUSIONS

The Biała Nida Valley bears very clear traces of warfare, mostly from World War II. Among the best-preserved forms is the clearly visible anti-tank ditch. It is part of the defensive fortifications built by the Third Reich in the final stages of the war. The over 80-year-old structure is preserved in varying degrees of condition, depending on the geological structure of the terrain on which it was built and the relief (mostly by the slope). However, modern land use is significant, especially accelerating the denudation processes of the World War II relics found here. The best-preserved sections of the anti-tank ditch and escarpe were carved into the steep limestone slopes of the valley, currently poorly accessible and intensely forested. The worst-preserved sections run through sandy and gravel alluvium used for agriculture, accelerating the denudation processes of the studied feature due to both natural and anthropogenic factors.

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